

• **Special Topic**

Policy Directions Addressing the Public Health Impact of Climate Change in South Korea: The Climate-change Health Adaptation and Mitigation Program

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Climate change, caused by global warming, is increasingly recognized as a major threat to mankind's survival. Climate change concurrently has both direct and modifying influences on environmental, social, and public health systems undermining human health as a whole. Environmental health policy-makers need to make use of political and technological alternatives to address these ramifying effects. The objective of this paper is to review public health policy in Korea, as well as internationally, particularly as it relates to climate change health adaptation and mitigation programs (such as C-CHAMP of Korea), in order to assess and elicit directions for a robust environmental health policy that is adaptive to the health impacts of climate change. In Korea, comprehensive measures to prevent or mitigate overall health effects are limited, and the diffusion of responsibility among various government departments makes consistency in policy execution very difficult. This paper proposes integration, synergy, and utilization as the three core principles of policy direction for the assessment and adaptation to the health impacts of climate change. For specific action plans, we suggest policy making based on scientifically integrated health impact assessments and the prioritization of environmental factors in climate change; the development of practical and technological tools that support policy decisions by making their political implementation more efficient; and customized policy development that deals with the vulnerability of local communities.

Keywords Climate change, Health impacts, Policy directions

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Need for Development of Policy and Techniques Addressing Health Impacts of Climate-change

According to the fourth report of the United Nations Intergovernmental Panel on Climate Change (IPCC), global average temperatures have increased over the past 100 years by 0.74°C, with a total predicted rise of 6.4°C by the century's end [1]. A broad swathe of scientific research has documented the adverse public health effects of such a shift in climate, such as increased

incidence of disease and overall mortality rates. The World Health Organization (WHO) has outlined eight categories of risk factors for environment-related diseases. Climate change sits high on that list [2].

The Korea peninsula is experiencing a rise in average temperatures higher than the global average. According to the Korea Meteorological Administration, average temperatures have risen 1.7°C over the past 100 years (from 1912 to 2008) [3]. The winter period has shrunk by 22-49 days and phenomenally heavy rains and high temperatures during the summer have resulted in

heat waves that have claimed the lives of 2,127 people between 1994 and 2005 [4]. Clearly, Korea is vulnerable to the health impacts of climate change.

As climate change brings real-world public health consequences, Korea has begun to investigate ways to address its impact on climate change and to develop responsive policies. Korea has developed four separate national climate change policies since it joined the United Nations Framework Convention on Climate Change in 1993. Of the most recently announced National Climate Change Adaptation Measures (2011-2015), public health is listed as the first issue out of the 10 sectors and seven adaptation measures listed in the report. The Ministry of Environmental Health's Master Plan (2011-2020) includes environmental health measures for adapting to climate change as one of 10 major initiatives and sets forth as an important policy initiative "a corresponding plan for health damage caused by climate change".

Despite these efforts, the Organization for Economic Cooperation and Development evaluated Korea as unsatisfactory in its efforts to implement preventive health impact and adaptation policies [5]. The implementation plan for adapting to climate change lacks specificity and the technical means to execute it successfully. Thus, a detailed implementation plan that coordinates the efforts of central and local governments is urgently needed. In a partial response, the Ministry of Health now operates the Health Impact Assessment and Adaptation Technology Research Center from 2011 to 2016, which seeks to lay the groundwork for policy implementation by the Korea Environment Institute.

The purpose of this paper is to explore the scope of policies dealing with the health impact of climate change and to examine the support system developed by the Health Impact Assessment and Adaptive Technology Research Center to explore future directions in health impact policy.

Trends in Climate Change and Health Policy

Climate change impacts ecosystems and societies around the world. The IPCC was conceived as a transnational council in response to climate change with the goal of setting global policy goals and spurring technological innovation to assist in those aims. The policies of the United States, the United Kingdom, and Korea, with regards to health impact assessment and adaptive responses through the IPCC will be examined here.

Intergovernmental Panel on Climate Change

The IPCC reported in its fourth assessment report about the

direct and indirect factors that affect public health [1]. The fifth assessment report, which will be published in 2014, includes natural disasters brought on by weather, air pollution, food and waterborne infectious diseases, vector-borne infectious diseases, and malnutrition [6]. The report also refers to investigations and research for vulnerable populations most affected by climate change.

United States of America

In 2010, based on opinions put forth by various government agencies, the US National Institutes of Health announced 11 key areas of health-related research [7]. These 11 areas of future research were further classified into four sections: first susceptibility, vulnerability, and refugee populations; second, public health and medical services; third, required technology and ability; fourth, publicity and education.

United Kingdom (UK)

The UK's climate change-related national planning pursues three intertwining strands: policy and program development; organizational development; and raising awareness and building partnerships. The climate change adaptation policies measure feedback to identify what is working and what is still lacking [8]. However, in the UK, in light of the magnitude and time-sensitive nature of adaptation measures to address the health effects of climate change, the adaptation measures related to public health demand separate specialized focus. Therefore, they have separated the adaptation policy for public health from the general national adaptation policy and have prepared, established, and managed a comprehensive adaptation policy for health effects of climate change.

Korea

As climate change adaptation issues emerged as national policy issues in Korea, various government sectors carried out their own policy research projects. Three comprehensive plans have been adopted since 1999. Recently, the National Climate Change Adaptation Measures (2011-2015), Environmental Health Master Plan (2011-2020), and the Five-year Plan for Green Growth (2009-2013) were developed by the Ministry of the Environment. However, the implementation of a comprehensive policy addressing the health effects of climate change is not an easy task.

The contents of research and development related to the health effects of climate change are cataloged in Table 1 [9]. Most of the studies deal with directions for future research and assess-

Table 1. List of projects addressing the health impact of climate change in Korea [9]

Section	Project title	Year	Research agency
Comprehensive counter-measures	Preparation of adaptation program and impact assessment for climate change of the Korean peninsula	2003	Ministry of Environment
	A study on establishing a long-term strategy for environmental health due to climate change	2008	Ministry of Environment
	The development of a climate change impact monitoring system and adaptation strategies for human health	2008	Ministry of Health & Welfare
	The development of climate change adaptation strategies for human health	2009	Ministry of Health & Welfare
	A study on building an action plan on public health due to climate change in Seoul	2009	Seoul Metropolis
Heat wave	Health impacts of climate change and adaptation measures	2005	Ministry of Environment
	Development of an extreme heat health warning system (I-II)	2005, 2006	Meteorological Administration
	Development of a response plan and health management plans for heat waves	2009	Ministry of Health & Welfare
	Methodology study for the cumulative effect of high temperature on mortality	2010	Korea Environment Institute
Air pollution	A study of the characteristics of indoor and outdoor air pollution and health impact assessment due to climate change	2009	Korea Environmental Industry and Technology Institute
	Climate change and air pollution effects in environmentally related disease	2010	Korea Environment Institute
	Spatial and temporal analysis for health impacts from climate change and air pollution	2010	National Institute of Environmental Research
	Health impacts of climate change and air pollution: effects of socioeconomic factors on mortality	2011	Korea Environment Institute
Vector	Managing the impacts of climate change on communicable disease outbreaks	2006	Ministry of Health & Welfare
	The climate change adaptation strategies for infectious diseases	2008	Korea Centers for Disease Control and Prevention
	Development of a monitoring technique for harmful microorganism as an action plan due to climate change	2010	National Institute of Environmental Research
Others	Climate change and burden of infectious disease	2009	Korea Institute for Health and Social Affairs
	Development of burden of disease due to climate change	2010	Ministry of Environment

Korea Environment Institute. Policy direction for assessment and adaptation in health impact of climate change. Seoul: Korea Environment Institute; 2011 [9].

Table 2. National climate change adaptation measures (2011-2015) in health sector adaptation measures and detailed projects [9]

Measure	Detailed projects	Research agency
Heat wave and UV adaptation	Health impact assessment and development of a monitoring system for heat waves and UV	Ministry of Health & Welfare, Meteorological Administration
	Preparation of measures in heat wave and UV damage mitigation	Ministry of Health & Welfare, Ministry of Environment, Meteorological Administration, Korea Forest Service
Meteorological disasters adaptation	Preparation of measures for monitoring and mitigation in health impact of meteorological disasters	Ministry of Health & Welfare
Infectious disease adaptation	Research and development of monitoring system for health impact due to changes in natural ecosystem	Ministry of Environment
	Strengthening of management and monitoring of infectious disease	Ministry of Health & Welfare
	Strengthening of research for infectious disease vectors	Ministry of Health & Welfare
Air pollution and chemical adaptation	Monitoring and development of vulnerability assessment system for health impacts of air pollution	Ministry of Environment, Ministry of Health & Welfare
	Mitigation from air pollution in vulnerable populations	Ministry of Environment
	Monitoring and development of vulnerability assessment system for health impacts due to changes in chemical fate	Ministry of Environment
Allergen adaptation	Strengthening management of allergy environmental factors	Ministry of Environment, Meteorological Administration
	Prevention and management of allergies due to climate change	Ministry of Environment, Ministry of Health & Welfare

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ment of the health impact of specific environmental factors related to climate change and relevant adaptation policy. Also, health sectors in the National Climate Change Adaptation Measures (2011-2015) is under the jurisdiction of four ministries;

the Ministry of the Environment, the Ministry of Health and Welfare, the Korean Meteorological Administration, and the Forest Service. Table 2 shows a summary of the adaptation measures listed by the health sectors outlined in the national climate

change adaptation measures (2011-2015) along with the challenges faced by each relevant ministry [9].

Development of Policy Support System (Climate-change Adaptation & Mitigation Program)

Under direction from the Ministry of the Environment, the Korea Environmental Industry & Technology Institute evaluated the health impact of climate change and drew up plans for a Health Impact Assessment Adaptation Technology Development Research Center (2011-2016), to be operated by the Korea Environmental Institute. The ultimate goal of the research scope and content of the research center is technology development, specifically, developing a climate change - health impact policy support system known as the Climate change Adaptation and Mitigation Program (C-CHAMP).

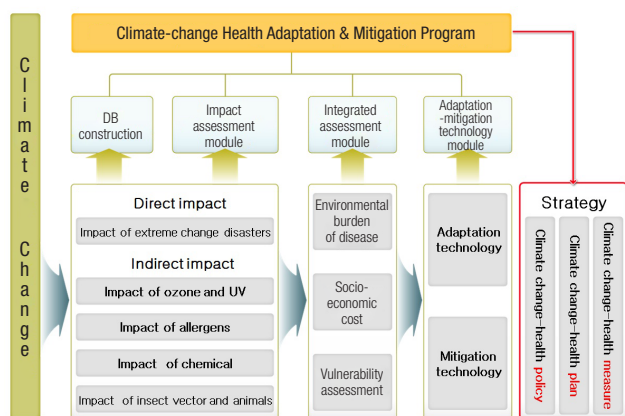


Figure 1. Climate-change Health Adaptation & Mitigation Program elements of technology development and policy application.

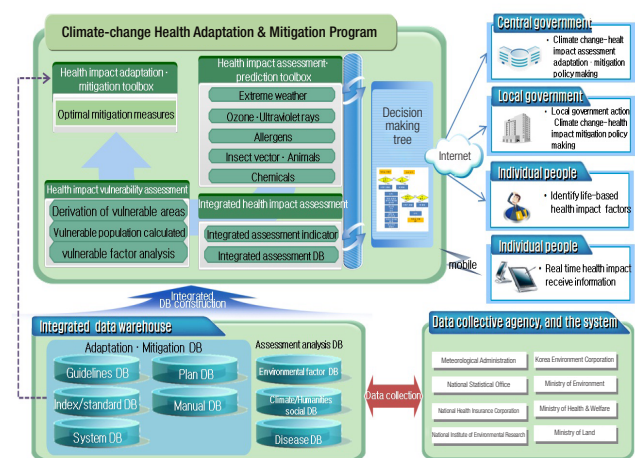


Figure 2. Climate-change Health Adaptation & Mitigation Program system overview.

System Goals

The Research Division's health impact assessment and adaptation to climate change is based on integration, synergy, and utilization. The research team's final goal is to develop C-CHAMP as a viable infrastructure capable of supporting the establishment of health sector plans and policies that are adaptive to climate change. The C-CHAMP system consists of an integrated database on the health effects associated with climate change, along with a health impact assessment and a predictive element technology toolbox consisting of adaptation and mitigation technology (Figure 1). These elements are needed for local government agencies to plan for the assessment and prediction of, and appropriate adaptation to and mitigation of climate change. They can be used as practical scientific tools to provide a means for adaptation and mitigation policy making (Figure 2).

System Components and the Development Phase

Humans are exposed to the direct and indirect impacts of climate change, so policy must be directed towards mitigating that exposure. The direct effects of climate change include higher temperatures and climate disasters, such as typhoons and torrential rains, heat waves, and floods. Indirect factors include increased air pollution, animal-borne diseases, poor water quality, and food shortages. It is necessary to identify these impacts and their adverse health effects and to develop adaptive and planned responses that reduce those effects. The research division of C-CHAMP conducts health impact assessments and develops adaptation technologies in response to each effect (Figure 1).

C-CHAMP development is divided into three stages. Stage one aims to build a health impact assessment and adaptation

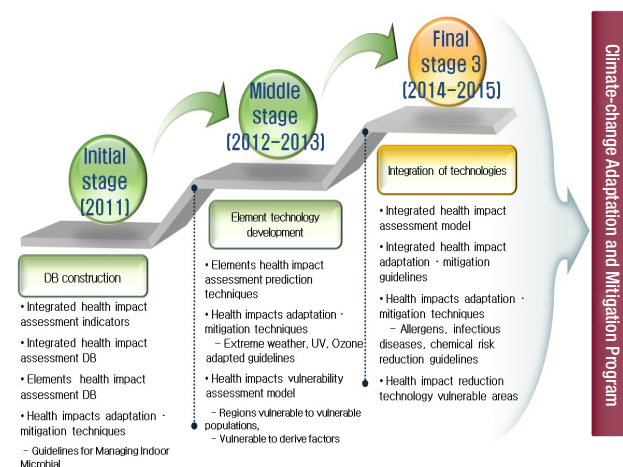


Figure 3. Technology development stage of Climate-change Adaptation and Mitigation Program.

database by the end of 2011. Stage two consists of developing technology in response to the recorded health assessments and adaptation needs, with a target date of 2012 to 2013. The third stage, a comprehensive Health Impact Assessment system with integrated adaptation technology will hopefully be complete by 2014 to 2015 (Figure 3).

Directions of Policy on Health Impacts from Climate Change in Korea

After examining Korean and international public health policies dealing with climate change and technological development, three things become clear. First, it is necessary to integrate technology development. Second, it is necessary for related agencies to synergize their various research projects and adaptive technology development. Finally, the policy needs to line up with the end-user.

Public health policy dealing with climate change has overwhelmingly focused on the correlation between climate change and public health impacts. Future research must identify and target the areas of greatest vulnerability and address their potential impact on public health. In addition, there is an urgent need to develop technological tools that can be used to support and execute policy decisions on climate change. Finally, integration, synergy, and policy based on the practical use of basic principles of climate change health impact assessment and adaptation policies are needed to promote technological development and workable strategy.

Policy Making Based on Scientific Integrated Health Impact Assessment

Generally, chain of causes and effects is extremely varied and complicated including both environmental factors and health (mortality and morbidity) effect factors, and among them the effect of health impact factors is relatively small. Current policies have focused on the health impact assessment of individual environmental factors. The focus should shift to integrated health impact assessment that considers various environmental factors taken together.

Development of Practical Tools for Supporting Policy Decisions

It is necessary to propose specific adaptation technology or methods in order to adequately support decision making and build climate change impact assessment and adaptation policies with regard to public health. It is necessary to have scientific tools

that can evaluate existing models or databases and predict the health effects of climate change. These climate change - health impact adaptation technologies should be built by subject, that is, the health impact factor, and by type of data, such as guidelines, indices and standards, system data, adaptation plan materials, and manuals. A system is being developed in the form of a toolbox for assessment, prediction, adaptation in which central or local government policy makers, academic experts and members of specialized research organizations, and the general public can search and query according to the hierarchy of user needs.

Customized Policy Development Dealing with Local Vulnerability

Health effects due to climate change are shaped by regional environmental factors as well as the specific health characteristics of the affected populations. The abundance of non-climatic factors affecting health makes it difficult to identify health impacts solely from climate change. The motto 'Think Globally, Act Locally!' means the large-scale causes of climate change must be addressed by solutions rooted in local and specific actions.

Thus, any policy that is sensitive to health effects caused by climate change must ultimately be "customized policy," that is, rooted in the specific local conditions of the region and factors in the needs and behaviors of the target population. When making any health impact assessment, various environmental factors at play as well as the results of any vulnerability assessments performed must be included. It is expected that a policy that reflects these needs will be much more effective than a one-size-fits-all approach.

Conclusion

Though the effects of climate change are global and far-reaching, we are primarily concerned about the human health effects brought on by this change. It is imperative that we develop policy to predict, evaluate, and address public health affected by climate change. Nonetheless, the kind of data accumulation needed to aid in the investigation of health effects of individual environmental factors in Korea is still in its infancy. It is very important to support and build a customized public health policy. Integrated health impact assessment and vulnerability assessment are needed to achieve more scientific and practical climate change and health impact assessments overall. Ultimately, these evaluation results will enable the establishment and implementation of health impact adaptation policy customized on the basis of regional and target population characteristics.

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Conflict of Interest

The authors have no conflict of interest to declare on this study.

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